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DEVELOPMENT:

INCLUDING

*INSTRUCTIONS FOR THE USE OF EIKONOGEN
AS A DEVELOPER FOR INSTANTANEOUS
WORK, AND A COMPARISON OF
DEVELOPERS.*

BY

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[AMATEUR PHOTOGRAPHER'S LIBRARY, No. 5.]

LONDON:

HAZELL, WATSON, & VINEY, LIMITED,

1, CREED LANE, LUDGATE HILL.

1891.

'OPTIMUS' LENSES.

Photographic News.

"We may call attention to the extensive optical and metal works that Perken, Son and Rayment have established in Hatton Garden, and their photographic cabinet factory in Saffron Hill. At the former we were much interested in the glass-grinding departments—one for photographic lenses, another for spectacles: and we were surprised to find in London such extensive workshops for the metal parts of cameras and optical lanterns; indeed, we thought outside Birmingham we should not find such workshops in the United Kingdom. The cabinet works in Saffron Hill also interested us much; the arrangement of the machine tools, and distribution of power on the several floors, being admirable."

Photographic News.

"We are pleased to find upon trial that the lens ('Optimus' Rapid Rectilinear) sent for review is really an excellent instrument."

British Journal of Photography.

"The 'Optimus' Rapid Euryscope manufactured by the firm of Perken, Son and Rayment, Hatton Garden, an example of which is on a camera on our editorial table. With full aperture of $1\frac{1}{4}$ in. (its equivalent focus being 11 in.) it defines with extreme brilliancy, and when used with a stop it easily covers a 10 by 8 plate to the corners, which is larger than that engraved on the mount as its possibility. Working as it does with such a large aperture ($f/6$ approx.) it serves as a portrait and group lens, as well as a landscape and copying objective. There is no doubt of its proving a most useful lens."—J. TRAILL TAYLOR.

PERKEN, SON & RAYMENT, 99, Hatton Garden, LONDON.

DEVELOPMENT.

IN treating of development I must assume a fair amount of knowledge, on the part of my readers, of the subject of exposures. Exposure and development are so closely linked together that it would otherwise be impossible to separate their effects. I shall, therefore, presume that my hearers have had some experience of this portion of photography, and have passed the *measles* stage, which consists of firing indiscriminately at every moving object, with the most rapid of shutters, wandering from one brand of plate to another that some lucky successful shot or good puff may happen to boom. I shall hope that they have passed this stage, and are beginning to appreciate the fact that it is really possible to produce artistic results quite independently of the use of some particular lens, plate, or marvellous long-named developer. My readers are, I hope, beginning to find that the world-renowned and much-discussed formulæ are not all that is required to develop a

plate ; it is not always sufficient to stick it into a universal Beecham-pill, cure-all, patent-one-bottle-solution, and leave it there for a stated number of minutes ; but they are beginning to appreciate that the developer has been given them to correct in some slight extent the inharmonious lighting of the view that they are photographing, a power of giving more brilliancy to a dull, lifeless scene, or toning down the too hard characteristics of a crudely sunlighted building, and that, at the same time, an intelligent development will enable them to correct to a certain extent—to a very large extent indeed, if they are aware of the fault—the errors of exposure.

And now let us thoroughly understand, I won't say the theory, but the rationale of development. In any view we have a multitude of points all sending out rays of light in every direction, and of all degrees of intensity or brightness, from the bright high-lights on the young shoots of the budding tree to the dim faint detail in the heavy shadows of the ivy. Every one of these points is pouring forth in all directions its light rays ; a certain number of these fall on our lens, and are, so to speak, siezed by this instrument and reformed up again into points at a certain spot situated in the focus of the lens. It is at this spot that we put our sensitive plate on which is to fall the view we are photographing. A photographic scene then consists of a mass of light rays of varying intensities, and a negative is our means of interpreting these intensities.

Now let us expose a plate to these varying intensities of light ; we shall find that there is no visible effect on the film. It is only by applying other chemicals that an effect is made

apparent. These chemicals are known as the developer. But even with the developer there is a great difference in effect between the action of feeble and strong lights of which our scene is made up. If the light be very feeble, in spite of any chemicals we may use, no effect is obtainable, and the film refuses to darken. It is, of course, possible to darken the plate if we produce fog, by using an excess of chemicals, but this, evidently, is entirely apart from the action of light, and could take place even on those parts of the film that have not been acted on at all. There is then a certain amount of light necessary to make an impression on the silver salt. This amount I shall call the *critical* amount, and define it as the least possible intensity of light, the action of which any developer can make visible.

After the critical point is passed, a brighter light, or what is nearly the same thing, the same light acting for a longer period, will under development cause the film to darken, at first not quite proportionally to the intensity, that is to say, if one second will produce a certain amount of blackness, two seconds won't produce quite double as much, but somewhat less; it then for a considerable time does darken proportionally to the amount of light, but on arriving at a certain point the proportion again varies, and at last the blackening attains a maximum, and no further increase of light affects it. Indeed, if the light be still brighter or its action longer, the film will actually darken less, and at last, if exposure be very much prolonged, will show hardly any signs of reduction under the developer. This phenomenon is known as that of reversal. It is fortunately rarely likely to happen in practice, except the most gross

error in exposure be made; and we will forget all about it, and simply occupy ourselves with the portion that blackens more or less proportionally to length of exposure or light intensity.

We have then settled on the following points. Our negative, after development, renders the scene it represents by different degrees of blackness, caused by the varying thickness of the reduced deposit in the film; and, within certain limits, this thickness varies proportionately to the intensity of the light that has caused it. But there is a limit to this thickness of deposit, or density, as it is commonly called. This point must depend on the particular positive process we intend to use for our print, and we will refer to it again. Suffice for the present if we say that we are bounded in one direction by a certain maximum amount of density, beyond which we *must* not go. We are equally bound in the opposite direction by the amount of light that will give us our critical exposure, that is, make itself apparent at all on the film; beyond this we *cannot* go. We are in every negative inexorably fixed between these points. When photographing a brilliant view we *must* give a sufficient exposure to be able to get out the deepest shadow (the critical exposure), and during the time necessary to do this, the high-lights will have acted so energetically on the film, that under the developer these would come out much too black and dense, for we admit the longer the exposure the darker the deposit. When, on the contrary, the view is flat, with no deep shadows and no bright high-lights, we should never get a sufficient depth of deposit on the high-lights before we had brought up out-

shadows to such density that they would practically cease to be shadows, and the plate would all be fog. At least, we should if we had only one fixed developer, but fortunately we can by varying the ingredients alter the action of our developer, and to what extent and in what manner we will now attempt to find out.

Now for convenience sake I prefer, instead of making an ordinary negative—which must always have a character of its own, what one might call its personal equation, and in which it is impossible to correctly estimate the relative value of light and shade—I prefer to make a special negative, where the relative values of light and shade are reduced to their simplest expression. Such a negative is known commonly as a *sensitometer*. There are two sorts to be found in the market—the “Warnerke,” where the different intensities of light are represented by squares of varying thickness of pigmented gelatine; and the “Spurge,” where the light intensity is actually regulated by allowing a constant and same light to pass through pin-holes of varying known diameters, by which means, of course, the light varies in its intensity as the square of the diameters of the holes. Personally I much prefer this latter system, as it much more closely represents the effect of an ordinary view thrown on the sensitive plate by means of a lens.

Instead of an ordinary negative then, we will use a sensitometer, which will give us a set of squares from 1 to 20 each one representing a certain known light intensity; equivalent, of course, also to time of exposure, for we assumed above that a light acting for a certain time is the same as half the same light acting twice as long.

Let us expose a batch of plates under such a sensitometer to a constant light for equal periods of time, and see for ourselves what a variation of the ingredients of the developer will do. We will commence our experiments with the correctly timed negative, one having had a normal exposure. I will define a normal exposure as one sufficiently prolonged to permit of the normal developer bringing out the deepest shadows we wish to appear in the negative. And the normal developer will be one which will do this in a reasonable time, without any risk of destroying or in any way (by fog or frilling, etc.) injuring the sensitive film.

These two definitions evidently depend on each other, and with an ordinary negative it is difficult to know to which to refer the effect obtained. But with the sensitometer this difficulty vanishes. We expose for a constant period to a constant light, and leave the plate any time we like in the developer. We then find out from observation the lowest square that shows signs of reduction (the critical square), and also that square that has attained the maximum density; and by the differences between these two points we can tabulate our results. Moreover, we are not particular whether it be the lowest, or the last but one square that marks the critical exposure. Each square represents equal increments of light, or periods of exposure, and we can, therefore, make any square our base from which to calculate.

Now, a developer generally contains three ingredients: the developer properly so-called; an accelerator—this may lie in a variation of the chemical power of the developer itself, such as obtains with the ferrous oxalate developer, or

may consist of the addition of another distinct chemical, as is done with the pyro or hydroquinone developers—and lastly of a restrainer, which may or may not be used, and which may either be a quality of the developer itself or a separate salt added.

It would be much too lengthy a matter to go into the results obtained by varying the constituents or activity of all the known developers, and I will therefore confine myself to the one I believe to be most generally now in use, that is the alkaline pyro developer, with ammonia as the alkali. Personally, I prefer liquor ammoniæ to the fixed carbonates; I will not say it is better, but it certainly is equally as good, and has, to my mind, the advantage of having greater potency for less bulk than the other alkalies.

I would not, however, advise any one who is used to any particular carbonate to replace it by ammonia, but I should advise a beginner or waverer to take it up in preference.

Pyrogallol is our developer proper. This is nearly always made up with a certain amount of sulphite of soda; this salt being added as a preservative of the pyro, that is, to prevent it oxydising and becoming discoloured. This is especially useful when ordinary and not distilled water is used; it has no action on the development—at least, if present in only small quantities. Various formulæ give you the most puzzling variations in the amount of this salt to be added to the pyro, but I do not think any of them have in any way improved on Berkely's original formula, which consists of four ounces of sulphite for each ounce of pyro.

The well-known sulpho-pyrogallol of the Platinotype Company is made up according to Berkely's formula, and is

the developer which I have used in my experiments. It has this further advantage, that it is made up so that every ten fluid grains contain one grain of pyro. For those who know not the luxury of using fluid grain measures, it will be quite near enough if they assume that each ten minims contain one grain.

I call pyro the developer proper, because it is undoubtedly capable of development without any further addition, although such use could not be practicable. We must first, therefore, deal with it, and fix on the quantity we are to use. It is usually the custom, for the sake of easy comparison, in writing of developers, to define them as being made up of so many grains of this, that, and the other, per fluid ounce of solution, and I shall, therefore, retain this nomenclature. We will now proceed to analyse the behaviour of developers made up with varying quantities of their component parts.

If we vary the quantity of pyro, keeping the alkali constant, we find that when the pyro is in a small quantity—say $\frac{1}{2}$ gr. to the ounce—we get but little density in the most exposed squares. As we increase the pyro, however, these will show greater density, but at the same time, we remark that the time of development is prolonged. The time is reckoned, of course, as that necessary for the critical square, the least exposed one, to make its appearance. We can assume, therefore, that increase of pyro gives increase of density. Varying the quantity of restrainer, bromide of potassium, or ammonium has very much the same effect as varying the pyro, and increasing the two has a double effect in the same direction. Bromide is essentially only a re-

tarder ; no amount of bromide will sensibly destroy detail.

Now taking a fresh batch of similarly exposed plates, we will vary the quantity of the alkali. We shall now get a very different effect with each increase of ammonia ; the critical image appears more rapidly, and the upper squares—that is, those that have had most exposure—show a want of density. When the ammonia is in too great quantities, general chemical fog will supervene over the whole plate. The maximum of ammonia that can be used must of course depend on the plate employed ; I have found with the brand I was experimenting with (bromo-iodide plates), that with 2 grs. of pyrogallol to the ounce, and no bromide, fog commenced when over 2 minims of .880 ammonia were added to each ounce of developer. But with even a slight amount of bromide— $\frac{1}{2}$ gr. to the ounce—3 minims could be used with impunity. Therefore we assume that increase of alkali reduces density.

In my experiments I made a very great number of variations in the ingredients of the developer, but there was one very conclusive fact visible in every trial, and that is, that the position of the critical square only varied in a very slight degree in all of them ; that is to say, that the amount of detail brought out by all these varying developers was always about the same—very remarkably so, indeed. With developers of such opposite characteristics as $\frac{1}{2}$ gr. pyro, no bromide, 6 minims .880 ammonia ; and 8 grs. pyro, 8 grs. bromide, and 3 minims ammonia, the same amount of detail was brought out, the same critical square made its appearance. It is true the time required for this square to appear varied enormously, from a few seconds up to some hours ; and the

general appearance of the negatives was totally different. That is to say, the gradation was totally altered. In the one developed with the excess of ammonia there was no density anywhere, the whole of the series of squares showed about the same thickness of deposit. In the other plate, on the contrary, maximum density had been attained very low down in the scale, and the whole of the upper and most exposed squares were merged in one solid blackness. If, however, the one with excess of ammonia was allowed to remain a long time in the developer, it gained also a very great amount of density.

Now there is only one conclusion to be drawn from these facts, and that is that the action of light is *absolute*; a certain amount of light will affect a certain amount of dissociation amongst the silver molecules that form the sensitive film, and any agent capable of developing will show a certain fixed amount of reduction. And whether we apply a vigorous or a weak developer, we shall never get out any more or less detail. There will, however, be a vast amount of difference in the time that will be necessary to get this amount of detail out. Now this difference of time in the appearance of the critical image has another very important bearing on the appearance of the plate as a whole.

Let us watch the behaviour of that square which has received the greatest exposure; the first signs of reduction under a normal developer will soon appear, and the square will rapidly darken up to a maximum point, beyond which it will not go. If we increase the alkali, it will attain maximum density a little more quickly; if we reduce the

alkali, it will take longer, but there will never be a very great difference—nothing like that which obtains with the development of the critical square.

Now see the result of this : whilst with a weak development, that is one lacking in alkali, we are waiting for the critical image to make its appearance, the most exposed squares are becoming abnormally dense, and the negative, as a whole, shows a wide difference of density between the lower and upper squares. If we take the thickness of our deposit on the critical square as represented by the figure 1, the next square will be represented by 2, and the next by 4, 8, 16, 32, and so on, and several of the squares which have had the most exposure will have attained a maximum density of deposit, which we will represent by 100.

Now taking a vigorous developer, one strong in the alkali, our critical square will make its exposure rapidly, the more quickly as the developer is stronger ; and the effect will, therefore, be that the upper squares will not have time to obtain a maximum density at all, and the difference of deposit on the different squares may be represented by the figures 1, 2, 3, 4, 5, 6, to 40, or even less.

I feel assured that this is the true theory of development, when dealing, of course, with a correctly exposed plate, viz., that density is chiefly a question of time of development, and the corollary follows that the maximum possible amount of density can be brought out by any imaginable developer, if time be unlimited.

The above results are, of course, but a *résumé* of all my different experiments. I have tried plates similarly exposed, with innumerable variations of the constituents of

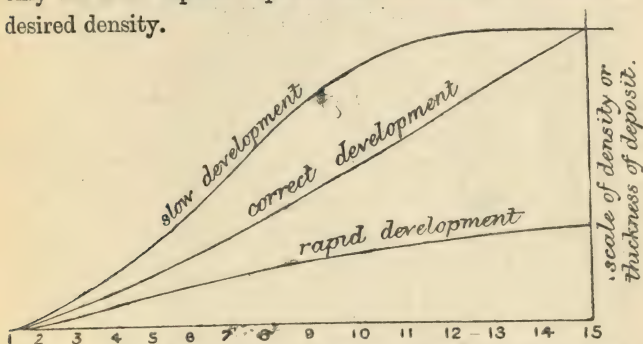
the developer, and compared the curves obtained in all possible sequences, but the only consistent results were obtained from the duration of the development, which in all cases gives results where the density of deposit varies as the time taken in development. To resume these facts, in a few words—with correctly exposed plates, slow development tends to give hardness, whilst quick development tends to give general flatness.

At the same time, we must not forget that practically—tor, after all, the time we can give to development is limited—the amount of pyro present also affects this question of density—that is to say, if the pyro be present in large quantities, the plate will blacken more quickly than if only a small amount were present. As a matter of fact, I find that the maximum quantity of pyro is about 4 grs., no difference being observable in the results obtained when 8 grs. are used. On the other hand, $\frac{1}{2}$ gr. may be considered the minimum amount practically of any use.

Now, how are we to pitch on a normal or correct developer from out of this jumble of experiments? It is a very easy thing. A photograph—or, for the matter of that, a picture—is made up of shadows, half tones, and high lights. In the negative the high lights are represented by the greatest amount of deposit, and the dark shadows by the least amount of deposit, and all the gradations between represent the half tones. Now, the quality of a photograph is dependent on the quantity of these half tones present. A picture with no gradation between the whites and blacks would be a hard chalky object. We must try and cultivate the widest range of *nuances* between these extremes, and choose for

our normal developer one that will give us these to the maximum degree.

We must then choose—between our rapid developer, that gave everything flat, no contrast whatever; and our slow developer, which gave us too much contrast—one which will just give us the full amount of gradation, but no more, where each square is slightly denser than its preceding one, growing gradually in thickness of deposit till only the most exposed square has obtained the maximum desired density.



I cannot do better than show you these results graphically.

The figures along the horizontal line correspond to the different squares of the sensitometer—that is, they represent the amount of exposure—and the vertical heights to the thickness of deposit or density of the negatives.

Following the bottom curve, which represents that obtained with a rapid developer, we see that it never does get any density. The upper curve, that obtained with a slow developer, has too much density. Several of the most exposed squares are represented by equal thickness

of deposit, and therefore will show no difference in tone on the print. In the middle curve, however we have a correct gradation; each different light-period or exposure is represented by a different thickness, and will therefore show a different tone on the print.

The developer with which I have obtained the best gamut of graduations, and which I will call my normal developer, is made up as follows:—

Pyrogallol	..	..	..	..	2 grs.
Sulphite of soda..	..	..	..	..	8 grs.
Bromide of potassium	..	..	..	..	$\frac{1}{2}$ gr.
Ammonia 880°	..	..	..	..	2 minims.
Distilled Water	..	..	..	up to	1 fluid oz.

Note.—Or, if sulpho-pyrogallol be used, 20 minims of this may be substituted for the pyro and sulphite.

But I attach no importance to this standard, as it is only correct for a correctly-exposed plate, like our sensitometer; if our plate be not so exposed, and we all know this frequently happens, this developer will no longer suit. Even a different brand of plates, or a change in the temperature of the solution, will somewhat affect it. So, although it is necessary to have a standard to start from, I should not advise the rigorous use of this precise developer; in fact, nobody can be more antagonistic to fixed developers than I am. They undoubtedly have their uses, to which I shall presently allude, but the use of a fixed developer for all classes of subjects will not be conducive to uniform, correct work.

We can never command our exposures, and development must be *tentative*; that is, we must feel our way, and alter the constituents of our developer to suit our exposures or subjects.

But this normal developer may be incorrect even although the exposure be correct. The view itself we are photographing may show too much or too little contrast. To take the time-honoured example, the whitewashed cottage and the dark ivy, we cannot imagine any greater contrast than between these, and if rendered as seen would give much too hard or chalky a picture. Or, on the other hand, the open view on a dull misty day will show no gradation whatever, and if rendered just as we saw it would give a vapid flat print, devoid of all contrast and sparkle.

But from our sensitometer experiments we can learn how to modify the gradation of tones in our negative, for we saw how increase of alkali, by causing rapid development, flattened the result; therefore in the case of our imaginary too brilliant picture we should evidently so pile on the accelerator as to get out all the detail before the high lights have had time to gain over-density, whilst in the case of our flat scene we should add the accelerator very cautiously, and increase the quantity of our retarders, pyro and bromide, and so give the higher lights every chance of getting their maximum density before the details in the shadows show. For decrease of alkali, by prolonging development, gives increase of contrast.

But now let us treat cases suffering from incorrect exposure. The two cases we have mentioned tell us the procedure to follow if our negatives are over or under exposed. What does an over-exposed negative mean? It means that the shadows have had so long an exposure that they are as ready to show, under a normal developer, as the high lights themselves, and therefore, if such a developer

be applied, everything will come up with a rush ; we shall be obliged to stop development, and therefore get a thin flat negative with no gradations at all. The remedy is obvious : we should apply more retarder. This would prevent the least exposed squares putting in too hasty an appearance, and allow the other squares time to gain a proper amount of density. And what is an under-exposed negative ? It is one where the deepest shadows have only just received the critical exposure, whilst the high-lights are fully exposed, and with a normal developer, whilst waiting for our shadows to appear, our high-lights have gained too great density. Our remedy is obvious—add as much alkali as the plate will bear, and force out the recalcitrant shadows before the lights have become too dense. The above example does not, however, properly represent an under-exposed negative, but merely a too brilliant view. Assuming a correct exposure to be the normal exposure as I have defined it, in an under-exposed negative it would be impossible to get out the details by any developer, since they will not have received the critical exposure. In a true case of under-exposure, not only will the critical square not make its appearance, but the high-lights also may not have had sufficient exposure for them to obtain a sufficient blackness of deposit, and the negative will be thin and weak all over ; in this case there is no advantage to be gained by any variation of developer. This is a true case of under-exposure—not the black and white negatives usually designated as such. Although this thinness is generally ascribed to the plate, which is branded as one “impossible to obtain density with,” it is, as a general rule, an error of exposure.

Let me here, at the risk of repeating myself, again go through, in a tabulated form, the procedure to adopt with these different classes of negatives.

- (1) *Over-exposure*, tendency to give a flat result; therefore, increase pyro and bromide, and reduce alkali; slow development.
- (2) *Under-exposure* (so-called), tendency to give hard and chalky prints; therefore, reduce pyro and restrainer, and increase alkali as much as possible; rapid development.
- (3) *Under-exposure* (true), tendency to give feeble negatives, lacking in density *everywhere*; slightly increase pyro, restrainer normal, slightly increase alkali; very patient development.
- (4) *Too brilliant a view*, tendency for negative to become hard, practically a case of so-called under-exposure; treat accordingly.
- (5) *Too flat a view*, tendency for negatives to be flat and thin; increase pyro and bromide, and reduce alkali; slow development.

We have now learnt theoretically the different treatment that negatives demand under all possible contingencies. How shall we apply this practically? We do not know if our negatives are correctly exposed or not; we must therefore work *tentatively*, feeling our way and watching for signs. These are, fortunately, very clearly and manifestly shown us. An under-exposed negative comes up slowly and recalcitrantly; portions, and these generally rather large, come up here and there, and begin to gather density, or else, if the exposure be very short, refuse even to darken at all. In a properly-exposed negative the details come out gradually and evenly, one shade after another, and the whole image grows, showing detail everywhere, except points of white in the deepest shadows. The over-exposed negative comes up with a rush, detail everywhere, no gradation; and if much over-exposed, the whole plate will appear as if fogged.

How then to proceed practically? Commence with a lesser amount of alkali, say one instead of two minims, and watch carefully. It is the first appearance of the image that gives you the key-note of your after-treatment; it may require a second minim to effect an appearance, and if none is seen in, say, a minute or two, add it. The image ought now to make its appearance, unless you have made a considerable mistake in exposure; watch it closely, for its manner of presenting itself must regulate your future conduct. It is by its first appearance that you see whether it is going to give a hard or a soft result. Should the image not appear after the second minim of ammonia is added, you can hardly hope for a first-class negative, but two minims is certainly not the limit of alkali that most commercial plates will stand. This amount varies naturally with the brand used, and you should find by experiment what amount the particular kind you use will take without being fogged. These quantities of ammonia refer to the normal developer as given on page 14. Some preparations of pyro and sulphite are made up with an excess of acid, and require considerably more ammonia than given above merely to to neutralise this free acid.

It may sound rather contradictory, but sometimes it is not very easy to tell by its appearance whether the image is over or under-exposed. An under-exposed image will sometimes make an appearance very suddenly, and perhaps a little startle a young hand; but the real point to be watched is not *one particular spot*, but the *whole plate*; if only *patches*, such as the sky, come up rapidly, no over-exposure is to be

feared; it is only when the whole surface everywhere appears simultaneously that such a danger is imminent. In a correctly-exposed negative the brightest parts should appear first, such as the sky, or water, or white buildings, or highlights generally; these are rapidly followed by the half-tones, then the detail in the shadows appears, and the plate goes on growing till only the merest specks of white emulsion indicate the position of the darkest shadows.

Now in a case of great over-exposure, beginning with a developer of the strength I first mentioned, the image would rush up, and before you could pour the developer off all the detail would be out, and something very like fog have made its appearance. I have found the best thing is to have by one a jug of citric acid solution—say 1 oz. of the crystallised acid to a pint of water—and on the image commencing to rush out in this unceremonious manner, tip a little into the developing dish. Don't stop to measure how much, but get it in as quickly as possible.

All progress is instantly stopped, the citric acid at once neutralising all the alkali, and, moreover, forming with it a citrate, which is in itself a wonderful restrainer.

You then recommence, so to speak, development, with the advantage that you know that your plate is over-exposed, and act accordingly, adding fresh alkali cautiously drop by drop to the old developer if you like, or you may make up a fresh one; and with a little patience you may still turn out a negative not far from perfect.

In a case of known over-exposure, it is a good thing to strengthen the pyro as well as the bromide, and of course add the alkali very slowly and cautiously. In a case of

known under-exposure, or too great brilliancy of view, you would commence soaking the plate in an alkali solution, which should be of the strength you would use for that plate, and add the pyro to that. The alkali softens the gelatine film, and lets the developer act more quickly on the silver molecules, and you will get your critical exposure out very rapidly, and therefore need not fear a too hard result.

In cases of doubtful exposure I would recommend soaking the plates first. The gelatine, swollen by water, allows the action of the developer to show itself more uniformly, and one is less liable to mistake over for under exposure. Some plates, however, this soaking does not suit, and bubbles are formed in spite of most vigorous washing. As a rule I don't recommend it. In some comparative experiments described in the *British Journal of Photography* the soaked plate always gave inferior results to the unsoaked one. One word of advice—don't stint the quantity of your developer. At least 5 ozs. should be used for a 10 by 8 plate. Of course, if you use one of those dishes where the plate itself forms the bottom, you can do with much less, 2 ozs. being then amply sufficient.

And now a few words as to chemicals. I shall deal only with the alkaline-pyro developer.

Unless you use always distilled water to mix your developers with, you should add an anti-oxydiser to the pyro such as sulphite of soda, together with an acid such as citric or, better, sulphurous acid—not nitric, as I have seen mentioned in one formula, this acid will at once transform the sulphite into sulphate, an inert, if not a deleterious, compound in the developer.

Of the quantity of sulphite to use, I have already spoken. If you make up your own solutions, I should strongly recommend you to make them up in the same proportions as sulpho-pyrogallol is made up—that is, a 10 per cent. solution. You will find it always so easy to be able to express at once the amount of grains per ounce of developer that you use. Nothing is more hopeless than to try and compare developers with some one whose A, B, and C bottles are made up on some different and more or less mysterious principles than your own.

Keep, then, your pyro in this form, which is called erroneously a 10 per cent. solution. The manner of making it up is, of course, to put the chemicals—that is, one avoirdupois ounce pyro, and four of sulphite (crystals)—into a ten-ounce measure, and add water till the amount measures nine ounces; each ten minims will then contain one grain of pyro. For your bromide the strength used need not much matter, as long as you know how much of the dry salt a minim or drachm of the solution contains. So, when working with large plates I make it up strong; when with small, weak. This is simply for the convenience of adding. Bromide of potassium being more stable than the ammonium salt, it is the best to use. The same as regards the alkali—taking ammonia first—I use it out of a dropping bottle. Now, a dropping bottle drops drops which, for the same fluid, are fairly constant. I find that with mine, and, indeed, most bottles, four drops represent 6 minims. That is, after counting forty drops you will find, if you use a measure, that it registers 1 drachm. I therefore add to two parts of my strong ammonia (880 deg.), one part of

water (by bulk) : each of my drops then represents one minim of strong ammonia. This is for working large plates; for smaller ones you should dilute it to any convenient strength. I prefer to have the ammonia in a dropping-bottle, as it loses less of its strength (there being no removing of the stopper necessary). In using the fixed carbonates I should also recommend you to make convenient solutions. Of soda, using the pure anhydrous salt, a 10 per cent. solution can be made; but, according to Mr. Chapman Jones, a 20 per cent. solution crystallises out. For potassium carbonate, as strong as a 50 per cent. solution can be made if you use the dry salt. All the wonderful formulæ we see in the papers never by any chance mention the particular kind of salt to be used. Two champions will gravely discuss the value of an extra minim or two of carbonate of soda, without ever specifying the particular soda they mean, without, probably, knowing that there exist two carbonates of soda, one anhydrous—that is dry,—and the other containing nearly two-thirds of its weight of water! Further, the common washing soda may be of almost any strength, and contains many impurities. In America, still another variety, containing two molecules of water, is said to exist.

You see the weakness of exact formulæ! I remember one especial developer that had, and I believe, indeed, has still, a great success. Many people wrote about the marvellous results they obtained with it; and it was some time before it was discovered that the formula in question should have been made up according to American instead of English measures: the difference being, that the former pint measured 16 instead of 20 ounces. Both *avoirdupois*

and troy weights were used in the same formula, and what really were its constituents remains, I believe, still a mystery. Fortunately, it did not much matter. Given an intelligent worker and a fixed formula, he will soon expose his plates to suit his formula, and get good results. Still, I do not consider this a correct way of working. I hold that one ought to alter one's developer to suit one's exposure, and not *vice versa*.

The more observant of you will doubtless frequently have remarked, and been surprised at, the very great difference in exposure given by different photographers, and not tyros at that, although they may be photographing the same scene, with similar lenses, and identical plates, and yet they will produce equally good results. We know now that in the various developments lies the key of the mystery.

One might almost divide photographers, or at any rate those of the one-bottle or fixed developer contingent, into two camps—the over and under expositors. The former naturally advocate the use of retarded developers and slow development, whilst the others are all for quick development and lots of alkali.

It is difficult to criticise either ; experience has taught them the necessity of their particular methods.

I consider, however, that one should always give the shortest exposure possible, and develop fairly quickly. As a rule I find a properly exposed negative should be completely developed in ten minutes, all told ; that is to say, you can develop six in the hour.

Now, having more or less settled the ingredients and

manipulation of our developer, we have a fresh and very difficult obstacle to surmount, and that is the moment at which we are to stop development; in other words, when has our negative gained correct printing density? We will once more return to our old friend, the sensitometer, our dictionary and grammar, and we will take a print from this, for this is what we intend to do with our negative. Now it is clear that the paper will darken most rapidly under the least dense square, and gradually less under each succeeding one. Now, after a certain time, the paper will have taken a maximum blackness, and a longer exposure will not affect it any more. When this stage is reached we shall find the paper under the other squares less and less dark, till, under one particular square, it shows no sign of reduction whatever. The opaqueness of the deposit of this square, then, is the density that our negative should have, for if we continue to print till a lower square shows signs of reduction, the two upper squares will show the same amount of blackness, that is, no gradation, and the shadows will have no detail. So that we have here at once an infallible guide to aid us in finding out the correct printing density of our negative. Moreover, we can find out the exact density that suits any particular positive process we contemplate using. We have only to take a trial print from a sensitometer, and the density point is at once determined.

I will now recapitulate the different manner of procedure in development to be used in the different classes of subjects you are likely to photograph. But I must repeat that these are merely indications to guide you into the right road,

and are not to be rigidly adhered to as hard and fast rules.

Sea and Sky.—As a rule, development should be slow, and restrained. Generally speaking, there is but little contrast in these subjects, and we must do all we can to exaggerate this, so increase both pyro and bromide. In clouds, unless moonlight effects are required, no great density should be sought for, but the negative should be kept thin and delicate.

Open Landscape will nearly always require a restrained development. With near foliage, however, we must increase the activity of our developer, and reduce the pyro, or we shall get a chalky effect between the shadows and lights on the leaves.

When photographing under trees, or in wooded hollows or lanes, we must considerably reduce the pyro, and increase the alkali, or we shall inevitably get the patches of sky that show through the branches, much too dense. We must hasten our development as much as possible, and get out the ultimate detail before the high lights have become too strong.

The same remarks apply to interiors, which should be treated the same way.

In both these cases you might reduce the pyro to $\frac{1}{2}$ grain per ounce; in fact, do everything to avoid contrast. The darker the room photographed, the more contrast will it tend to give.

For portraiture we also require soft delicate negatives full of detail. Pyro should be reduced to one grain per ounce, and the plate should never be allowed to gain too great density.

In portraits taken out of doors, however, this no longer

holds good, for here the lighting is too general, and the result would be too flat, if we did not try to improve it by creating a little more contrast by scientific development. However, it is a fixed rule never to make a portrait too dense; it is next to impossible to satisfactorily retouch a too dense negative.

In copying, the most difficult branch of photography, we must do all we can to gain vigour. The radiated light, especially from an albumen print, is always lacking in vigour, and we must do all we know to regulate it by a restrained but rich developer; double the pyro and bromide, and add the alkali with great caution and care.

In copying line work, another difficulty sets in. If we are too slow over development the fine dark lines of the print, represented by clear glass in the negative, are very liable to be clogged up by the spreading of the reduced molecules of silver in the surrounding film. So difficult is it to get satisfactory results, that special plates are made for this kind of work. Densities should be as great as you can get, short of blocking up the lines.

The choice of the most suitable developer for instantaneous work is only difficult on account of the trouble in knowing what is embraced under this heading. The greatest portion of instantaneous work falls under the category that we have just gone through. The negatives have just had sufficient exposure, and none to spare, and they must be treated on their merits. If there is a superabundance of high lights, the development must be energetic, and if, on the contrary, flatness is feared, the development must be slow. As a matter of fact, in shutter work the majority

of the subjects get a correct exposure, and are, therefore, easily and correctly developed by any reasonable developer, We have, moreover, the advantage, that having no fear of over-exposure, we can start with a normal developer.

Of course, we do get instantaneous work where the exposure is below the minimum, where even the high lights have not had sufficient. For such a case we want a developer rich in pyro, very little bromide, and a fair quantity of alkali; say,

Pyro	4	grs.
Bromide	$\frac{1}{2}$	gr.
Ammonia .880	3	minims
Water, up to	1	fl. oz.

and, more than anything else, patience, plenty of patience. If you really want to save such a negative you may have to leave it for an hour, changing the old for a new developer occasionally; but, of course, you can only do this sort of thing if the whole negative, and not parts, are under-exposed, for then you have no fear of getting too much density anywhere, for nowhere has the film been sufficiently exposed to darken to a great pitch.

It is coming back to one of our earlier statements, that the action of light is absolute; a certain exposure will only give a certain darkening, however long development be prolonged, or however vigorous the developer be. It is only experience that will teach us, first, the correct exposure, and, secondly, how to tell by the action of the negative in the developer whether it was correctly exposed or not, and this experience must be learnt from experiment; and therefore I advise every beginner to perform for himself some of the experiments I have described.

Now there is no need for every amateur to have a sensitometer in his photographic kit; he can perfectly well use ordinary negatives for the same purpose, and I again earnestly advise all beginners to expend some few plates experimentally before they attempt practical photography. Unfortunately, most photographers will commence on more ambitious subjects, and if they do happen to make a correct exposure—and the odds are they will—they of course, get a successful negative. They ascribe this to the developer, and swear by its mystic symbols, till wrong exposures commence again, and they throw it over, only to take up a fresh developer or fresh plates which have given them good results, again only through correct exposure. I am confident whenever I see some marvellous new developing formula, that it is only another case of the gratuitous advertiser having made a correct exposure, which can, I really think, be developed successfully by anything.

It is a most important thing to learn exactly the appearance of a correctly exposed plate under the developer. When I first started photography, I had read up a lot about altering the constituents of the developer to compensate for over and under exposure, and I so effectually altered the constituents that by the time the negative was completely destroyed, I could never tell whether to ascribe its loss to the exposure or the developer.

Therefore make a point of practically learning the characteristics of incorrectly exposed plates. Take half a dozen views of the same subject, at nearly as possible the same time, but give them widely different exposures, say, $\frac{1}{10}$, $\frac{1}{4}$, 1, 4, 8, etc., seconds, and then develop them separately, but

use rigorously one normal developer, such as I have given—and watch the results. You will see how least and longest exposed ones behave, and learn to recognise their appearance; amongst them all you will find one which gives you the best results—correctly exposed, in fact. Now take a fresh batch of half a dozen with correct exposure, and try and get variations in gradation, by altering the constituents of your developer. Try and get a flatter or a more vigorous result. You will come to no harm, even if you throw away a good many plates on these experiments, you will gain such a thorough knowledge of the capabilities of your developer. You should make experiments in correct density by the same method. Expose correctly, and use a normal developer; but take the plates out of the developer at different times, so that the last plate is very much denser than the first. After fixing, take a batch of prints from all the negatives, using the same light, and see which gives the best result. This is your standard negative you should keep by you, and always work up to in practice.

If you make such experiments carefully and systematically, you may master the practical details of the process very quickly. The artistic qualities so necessary to make a successful picture are innate in us, and if not present, are not to be learnt in a day, but there is no reason why the mere scientific manipulation should not be mastered in a few lessons.

But you must instil some reason into your experiments; it is of no use to merely expose a plate, and content yourself by saying, "It is no good, let us expose another," if you do not find out *why* it was no good.

You must go through a little, a very little amount of drudgery, and throw away a few plates and waste a little time in experiments. But hereafter, believe me, you will acknowledge that your time was not wasted, nor were your plates thrown away.

EIKONOGEN AS A DEVELOPER FOR INSTANTANEOUS WORK.

SINCE the preceding articles on development were published in the *Amateur Photographer*, a new star has made its appearance in the photographic firmament, in the form of a new developing agent, which has had the name of eikonogen (image producer) given it, in place of its longer, and, although, perhaps, more scientific, still decidedly less practical cognomen. I have experimented a good deal with this new salt, and as I find that it possesses for a certain class of work some superiority over the alkaline pyro, or, indeed, any other system of development with which I am acquainted, I think a short description of its practical use may be acceptable as a sort of appendix to my former articles.

Although it is such a short time since eikonogen was introduced into this country, it has already gone through a complete transformation in appearance and character, and the samples that are now sold vary very widely from the original ones that were first sent over. The sample that I first obtained had a dirty-brownish, sandlike appearance, and gave, with or without sulphite of soda, strongly coloured and sometimes muddy solutions, whereas the new salt

is in clean and well-formed crystals of a lemon-yellow hue, and gives only faintly coloured solutions. I made a very exhaustive series of experiments with the original salt, and though fully recognising its great possibilities under certain conditions, found its use to be impracticable owing to the rapid deterioration of the mixed and unused solutions, whilst its sparing solubility in water rendered it impossible to make up the developer just as required. But, as I find that the new sample is free from these faults, or the more important of them at least—that is, that of oxidising rapidly before use—I have again carefully examined its behaviour, and find it to be an exceedingly valuable developer for that class of work which is usually designated by the title of *instantaneous*.

For the ordinary class of time-exposure work, where we can give the exposure we think fit, and where the size and importance of the negative compel us to expend time and thought on its development, eikonogen is in no wise superior to pyro; indeed, it is, perhaps, inferior to it. In the earlier portion of these papers, I ascribed my preference for ammonia as the alkali, to the fact that it could be used in a very concentrated form. I have shown that a difference in the quantity of pyro per ounce of developer affects the gradations of the negative; in other words, the mere addition of water effects a change; and if, therefore, we are working with substances that require a large quantity of water to dissolve them, when we add any to the normal developer, we shall not only get the effect due to the addition of the substance itself, but also that due to the general dilution of the developer. I think the great favour with which pyro

and ammonia is looked on by so many workers is for this reason. With these chemicals, in concentrated solutions, we can entirely and instantly effect a complete change in the character of the developer, and that without adding as well a flood of water.

Now eikonogen is entirely deficient in these qualities. It is very sparingly soluble in water—indeed, in some cases a saturated solution is not too strong; and, moreover, the addition of the alkali does not very much alter its action on the silver film. For this reason, therefore, I can't recommend its use for the majority of work.

But it has one very great and peculiar advantage, and that is, its power of giving density to the under-exposed portions of any negative.

Referring to the diagram I showed in my former paper (*vide ante*, page 13), if the uppermost line be assumed to show the utmost density obtainable by pyro, a still shorter and steeper curve would represent that obtainable by eikonogen. In other words, its real practical use comes in in true cases of *under-exposure*; that is, where no part of the plate has had anything like a sufficient exposure, or where, owing to the flatness, or want of contrast in the lighting of the view taken, difficulty is apprehended in getting enough vigour in the negative.

In such cases eikonogen is decidedly superior to pyro. Another great advantage given by it is the entire freedom from fog and the general cleanliness of the results. It is a well known fact that some plates, and more especially if they be old, tend to give green fog, accompanied with iridescent markings on the film; and this is more manifest, under the

action of ammonia. Green fog is certainly not peculiar to ammonia, as I have seen it with ferrous oxalate development, but the metallic marblings on the film are, I think, peculiar to this alkali.

In all ordinary exposures the ammonia is not likely to be present in sufficient quantity to cause such fog, but in dealing with instantaneous work, the amount may occasionally be overdone, and the discolouration result, but this will be more apparant and more irregular if several negatives are being developed at once — in other words, where less care is being exerted.

Now, plates exposed in hand-cameras are usually developed under such circumstances; the plates are generally of small size, and many of them are exposed at one outing, and having had all about the same exposure, which is usually the minimum possible, they are therefore often developed several at once. It is in such a case that eikonogen comes in particularly useful; it is the most suitable developer possible for short exposures, and it can be used for several successive negatives without in any way staining them. For the development of films, such as the new rollable celluloid film of the Eastman Company, it is all we could wish for, and several can be developed at once in a dish, in the way prints are toned in the gold bath, with no fear of stains or markings, a result which I must confess would be most difficult to obtain with pyro and ammonia. The development will not be a rapid one—on the contrary, it will be rather slow—but there is hardly any need to watch its progress, the action of eikonogen being so uniform and regular. With pyro developed negatives, if they

were left standing in the bath without rocking, granular markings all over the sky would probably appear, but eikonogen under the same conditions develops clear and clean.

It is for these reasons that I recommend this salt for the development of hand-camera work. I must emphatically state, however, that eikonogen will not produce or bring out *any more detail* than can be obtained by pyro and ammonia, but it will give greater density to the under-exposed parts than the latter, and this without any danger of causing fog or staining, and therefore workers must not reduce their exposures under the mistaken idea that eikonogen will help them to bring out what is not on the plate.

Development by means of eikonogen is like that with pyro, an alkaline one, but in this case the alkali is already contained in the eikonogen, which is the sodium salt of its complex carbon radicle, and it is capable of developing a plate in a fairly satisfactory manner without any other addition; in this respect it resembles ferrous oxalate rather than pyro, which cannot strictly be said to be capable of developing a plate *per se*. But this fact brings with it an attendant disadvantage; like ferrous oxalate, the solution will not keep well in contact with the air unless some other preservative agent be added. It is only natural that this should be so. We know that every developer only possesses developing powers from the fact that it is capable of absorbing oxygen, and as it is evidently not particular from where it gets the supply, it is clear that it will equally well absorb that from the air as that from the sensitive

film, and will gradually deteriorate without being used at all. The same obtains in a less degree with pyro, and for this reason when we wish to keep it in solution, we add sulphite of soda. We follow the same practice with eikonogen, and add sulphite to our stock solution. The amount I add is twice the weight of the eikonogen present; this is somewhat less than that usually recommended, but I am inclined to think that sulphite has a tendency to lessen density, and as I find that the quantity I use will allow the stock solution to keep very well, I do not trouble to add more.

If, however, it is proposed to use the same solution over and over again, as some workers do, then a further addition can very well be made, and four times the weight used, but personally I am not in favour of using old baths; that is to say, baths kept for more than a day, their developing powers are represented by such a very unknown quantity.

It is somewhat difficult to determine the precise solubility of eikonogen; it varies with the temperature considerably, but I consider it, at a normal temperature, to be about 15 grs. to the ounce, and a saturated solution may be considered to be of that strength, and it is in this form that I make up my stock solutions:

I first dissolve in 10 ozs. of boiling water 300 grs. of sulphite of soda (crystallised), and when this is thoroughly dissolved I add 150 grs. or more of eikonogen, so as to have a little crystallise out on cooling.

The alkali, carbonate of soda, is made up of a strength of 300 grs. to 10 ozs. of water, to which is added 10 grs. of bromide of potassium. The normal developer is

made up by taking 1 oz. of the eikonogen solution, and adding to it half an ounce of the soda solution.

The strength of the above developer is, when reduced to grains per ounce.

Eikonogen	..	..	..	..	10 grs.
Sulphite of soda	..	..	..	..	20 „
Bromide of potassium	..	..	..	..	$\frac{1}{2}$ gr.
Carbonate of soda	..	..	..	..	10 grs.
Water, up to	..	..	..	.	1 fluid oz.

If preferred, the developer can be made up at once of this strength in one solution, as it keeps well, although not so long, of course, as if made up in separate solutions.

If the mixed solution is prepared—and there is a good deal to be said in its favour—the best way of keeping it, is to fill completely small bottles of any convenient size, and then cork them up carefully. In this way I should think the solution should keep almost indefinitely, but, of course, the chemical has not yet been long enough under photographers' notice to be able to make any definite assertion on this point.

It must be distinctly understood that the developer made up as above is only for *instantaneous* work having had a minimum of exposure. As I have pointed out before, a good deal of this class of work is not, strictly speaking, under-exposed at all, and with such the above developer might tend to cause fog, and give too great density. If such should be found to be the case, the quantity of alkali should be reduced, and more water added, when development will be much slower, and perfectly under control. On the other hand, if through great under-exposure, the

plates refuse to gather density under this normal developer then the saturated solution may be applied to them; and if they are left a long time in this, if density can be obtained, it will be. It may be advisable to make up a small amount of the saturated solution in which a little carbonate of potash (10 grs. to the ounce) and bromide ($\frac{1}{2}$ gr. to the ounce) have been dissolved. This will allow the plates to get their full density in less time, which may be advantageous in some cases.

With regard to the colour of the deposit on negatives developed with eikonogen, it is of a bluish-black colour, very similar to that given by ferrous oxalate. This fact must be remembered in determining the density to give to any negative. Generally speaking, it is less light resisting than the deposit on negatives developed with pyro and sulphite (sulpho-pyrogallol), and considerably less than that obtained from the use of dry pyro, and therefore eikonogen negatives should be pushed slightly further than the others.

Although eikonogen can be very successfully used for longer exposures, it is, I hold, in such cases, inferior to pyro, for the reasons I have stated above; but for the short exposures of the hand-camera it will, I venture to think, be found a most useful adjunct to the alkaline pyro developer. It is not the place here to speak of its use in the development of lantern plates, and gelatine chloride or bromide papers; sufficient to say, that it is most suitable also for this class of work, and, in fact, entirely replaces, and is much superior to, either ferrous oxalate or quinol, the two developers which have hitherto held this place in the dark-room.

A COMPARISON OF DEVELOPERS.*

NATURAL historians will tell you that whenever a new species is introduced into a new country it begins to multiply and increase to a most alarming extent, but after a few generations Nature reasserts her ordinary law, and the new arrival settles down to its ordinary and normal rate of increase. In photography we find somewhat of a parallel: the advent of any new process is received with a burst of enthusiasm, its application is universal, and its merits or faults are extolled or condemned with as much exaggeration as any unpopular Government measure in Parliament, and it is not until the first effervescent exuberance of its disciples or the deep anathemas of its opponents have subsided, that it is possible for the still, small voice of reason to make itself heard, and allow the new comer to be judged strictly on its own merits.

Our latest advent from other climes is Quinol; this is, however, not of foreign origin, being no other than an indigenous species, which, under the name of Hydroquinone, was first proposed and introduced to the photographic world by our worthy President, and that in this very room, and from the rostrum that I myself am now occupying. On its first introduction, however, it did not meet with any general favour, and it was not until, like old brown sherry,

Read by Mr. Lyonel Clark at the Camera Club Conference, 1889.

it had made a voyage across the seas and back, that it was found good enough for the palate of our connoisseurs.

Slight as was the enthusiasm with which it was first received, its restoration to the land of its birth was, however, attended with the most fulsome flattery, and all that exuberance of expletives for which our Gallic brethren are so justly famous. The new developer was to do everything and anything: a very conjuror's bottle, out of which could be got the restrainer of over or the accelerator of under exposure—a very panacea for all our photo-genic woes or maladies. One loquacious apostle of hydroquinone, carried away by his own enthusiasm, actually went so far as to style it an “automatic” developer, thus abolishing at one fell swoop all the science and beauty of development, and all the power that chemistry has put into our hands, to compensate for its own shortcomings, or the unwillingness of nature, and to enable us to relieve our beloved pursuit from the reproach that it is a mere mechanical process.

But these furious atmospheric disturbances have now subsided; we have left the roaring forties of exaggeration for the quiet doldrums of reason, and Quinol, as I prefer to call it, is on its trial at the bar of the photographic world. The case was opened by Mr. Swan, in the Photographic Society's rooms, but a short time back, when this gentleman in a most able lecture very fairly stated its merits. But, on the principle of an old proverb—if I may venture to say so—I do not consider that Mr. Swan carried his investigations far enough. Development is a fairly complicated phenomenon. There is something besides the mere bringing out of detail or getting density; there are the gradations, or in-

tensity scale of the negative to be looked after, and this I consider the real secret of universally successful development.

A photograph of nature is made up not only of high-lights, half tones, and shadows, but of every gradation or nuance between these salient divisions. However white the paper we make our prints on may be, it will always be less so than the bright high-lights, and the deepest blacks of the print will be behind the dark shadows of nature. We have then to compress the scale of tones of nature into the short gamut that our printing processes give us; and it is therefore evident that the developer that can give the greatest range to this gamut will *cæteris paribus* be the most useful.

To make this point clearer, a certain light intensity will give the least appreciable deposit after development on the sensitive film, whilst the darkest deposit that we can admit, this point depending on the particular printing process we intend to use, we will assume to be obtained by a light one hundred times as intense. In exposing we must expose long enough for any desired detail in the shadow to impress itself on the plate. We will take this amount of light as our unit. Now any light one hundred times as bright as this unit point will then be represented on the plate by the maximum amount of deposit possible; and therefore any lights that in intensity are superior to this figure must all be represented by an equal amount of deposit; that is to say, they will all give the same appearance on the print, and we shall lose all detail in the high-lights. Now suppose that, by some modification of our developer,

we could so manage that our maximum deposit was only attained by a light two hundred times as intense as our standard minimum, I think it will be allowed on all hands that this is not only a valuable, but an essential property.

It is to ascertain what are the capabilities of quinol in this direction as compared with pyro-ammonia and ferrous oxalate, that I have undertaken the following experiments. I have not sought in any way to find out the developer that will give the most detail on a plate; from a very exhaustive series of experiments that I made last year, I was led to the conclusion that no alteration in the constituents of the developer, in any way affected the amount of detail that was brought out, provided that sufficient time were given. I believe Mr. Cadett has also come to the same conclusion, and as my present set of experiments shows the same result, I think we may consider it as an axiom, that the action of light on a dry plate is absolute, and no strengthening of the developing agent can bring out what does not really exist.

Mr. Swan, in his experiments, made a comparison by means of ordinary negatives. I have seen these negatives, but I have found it most difficult to make any very reliable deductions from them, and even Mr. Swan was obliged to acknowledge that it required a long and careful examination. I, therefore, in my experiments, decided to use a graduated sensitometer screen, which may aptly be described as a negative reduced to its simplest expression. The plates used were the Castle brand, the same as those used by Mr. Swan; they were all exposed to a uniform light behind ground-glass for equal periods of time. The

time was taken from a pendulum beating half-seconds, and every care was taken to ensure the negatives being equally exposed.

The developers compared were :

Pyro and ammonia.

Quinol and caustic soda.

„ carb. soda.

„ carb. pot.

„ ammonia

Ferrous oxalate.

The pyro used was sulpho-pyrogallol, and the quinol was Byk's, and was made up the same as the pyro with four times its weight of sulphite of soda, acidified with sulphuric acid. The caustic soda was the fused in sticks. The carb. soda was the anhydrous salt, and the carb. pot. the ordinary one of the pharmacopœia. The ammonia was the ordinary so-called 880 degs., but I cannot guarantee its strength. The ferrous oxalate was made up of acidified saturated solutions of potassium oxalate and proto-sulphate of iron. The restrainer used was invariably potassium bromide.

At the risk of being prolix, I will again state exactly those points in development I was investigating. Some little time back, I saw some photographs by Captain Abney; they were of snow scenes in the Upper Alps, and although the range of tones between the bright reflected light on the snow, and the deep shadows in the fir-trees was enormous, yet they were all proportionally represented in the photograph, both as regards the details in the shadows of the trees and in the high-lights of the snow. These plates were developed by pyro and ammonia, and Captain

Abney was kind enough to make known the particular formula he used for these views, which will be found on page 24 of vol. ii. of the *Camera Club Journal*.

In my own mind, I set this result down as the standard of excellency that any developer must attain in order to come into universal use.

How far quinol was capable of doing this the following experiments will, I hope, show. I will not weary you by going through them *seriatim*, but rather give you my deductions.

Commencing with pyro, we find the following laws; by decreasing the quantity of pyro, the alkali remaining constant, we get loss of detail, and also loss of density in the high-lights; If, however, we continue development long enough to bring out all the detail, then the density in the high-lights has also increased, and the result is what I call normal. If, however, whilst keeping the pyro down—say, $\frac{1}{2}$ grain (all quantities are in grains per ounce of developer), and increase the ammonia up to four or six minims—we find that now we can get out all the details before the high-lights gather any great density, and, therefore, we get a long low curve. This is precisely what we require; we have brought out the detail in the shadows, and the high-lights have not yet assumed any over-density, although by the suitable addition of more pyro we can at any time get any amount that we may desire.

Now, as to the behaviour of quinol under such circumstances, I am sorry to have to admit that it totally fails; its action is very distinct from that of pyro. If we decrease the quinol we lose detail, just as in pyro, but if we increase

the alkali, unlike the pyro developer, we get no increase in detail, or, what is the same thing, no increase in the speed with which it appears, unless we add the alkali to a most enormous and impracticable extent, and this is practically the same whatever alkali be used. Ammonia appears to promise the best results, but it has to be added to an enormous extent, and then green fog makes its appearance with as much vigour as in any pyro-and-ammonia developed negative.

To recapitulate the salient differences between pyro and quinol; the attainment of a low curve of intensity practically means that the detail, or least exposed, portions must be brought out rapidly before the high-lights, or most exposed portions, have had time to gather density, and this may be said to depend on the speed with which those details can be brought out. Now, when a small quantity of pyro is present, increase of alkali means increase in the speed with which the detail appears; but with quinol, on the contrary, increase of alkali, in reasonable quantity, does not mean increase in the speed of development. In order to obtain this, the quinol itself must be increased, in which case the development can be made most rapid, but unfortunately it is attended with an equal increase in density. The experiments show this most conclusively. Potassium bromide remains constant throughout. As its action is always to increase density, and as I was striving to keep density down, it became unnecessary to take this salt into account, although I found that a little is necessary to prevent a general slight reduction of the presumably unexposed portions of the film.

I found no practical difference in results when using the fixed instead of the caustic alkalies; development was undoubtedly more slow, but the gradations were practically the same.

With ammonia, I found the greatest difficulty in getting any sort of an image, unless both the ammonia and the quinol were increased to a very great extent. I find one note, that with a half-grain of quinol no image showed after ten minutes, although 25 minims of pure ammonia were added. The whole of the results with ammonia give green fog and metallic fog in a most virulent degree, and prove, I think, pretty conclusively that quinol is just as prone to fog as pyro, when used with the same alkali.

Passing now to the negatives developed with ferrous oxalate, we see that the rate or speed of development increases with the amount of the potassium oxalate present, so that it is possible to somewhat vary the gradations of the scale. One curious note is that diluting the ordinary developer with water increases the density of the negative very considerably, it being directly antagonistic to the result of having the oxalate in great excess.

From the above series of experiments I am led to deduct that, as far as regards the getting out of detail, pyro, quinol, and ferrous oxalate are all equal. As regards density, that is, the getting of the greatest amount of deposit for a given time of exposure, quinol and ferrous oxalate have, perhaps, the advantage over pyro, but my pyro series of experiments do not obtain any specimens specially made with the idea of getting density; so that it

is quite possible that pyro may hold its own even in this, in most cases, very undesirable respect.

With regard to getting a low intensity curve, pyro is a long way the best, ferrous oxalate comes next, and quinol last. I am, therefore, led to believe that for negative work quinol will never oust pyro, to which I consider it decidedly inferior. It is, of course, difficult to make any statement as to the anti-fogging tendencies of quinol, but I am inclined to believe that this is simply a question of the alkali that is used; with ammonia, even with small quantities, quinol gave me green fog as badly as any pyro developer ever did, and I therefore consider that it is not altogether so successful in this direction as one has been led to suppose. Quinol is not as soluble as pyro, and therefore presents a certain disadvantage from the point of view of ready carriage; and, lastly, quinol is more expensive than pyro. Therefore, taking all these considerations into account, I do not think that quinol is destined to continue long as a developer for photographic negatives. As a developer for lantern-plates, owing to the great beauty in the colour of deposit that can be obtained by it, it may possibly live long and prosper, but as a developer of negatives its restoration to the country of its birth will be as short as the historically famous restoration of the Stuart dynasty.

